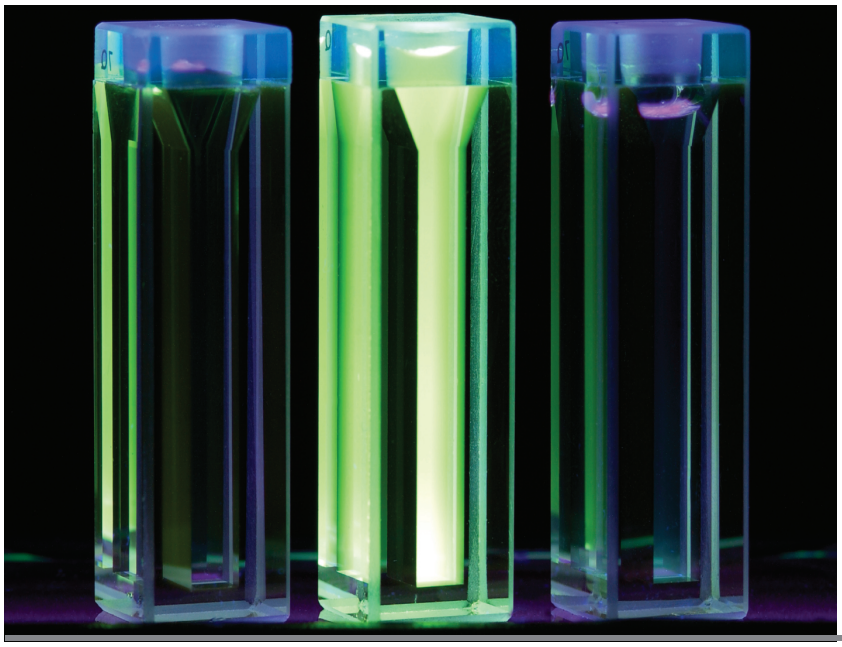


National Aeronautics and Space Administration

TECHNOLOGY SOLUTION

Sensors

Biomarker Sensor Arrays for Microfluidics Applications

For multi-color imaging and processing of single-molecule life signatures

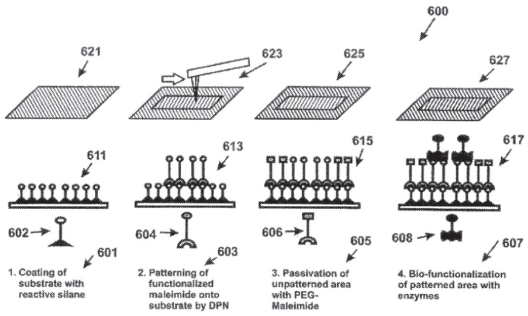
NASA's Jet Propulsion Laboratory (JPL) offers a method to manufacture biomarker sensor arrays with nanoscale resolution and active regions on the order of 1 micron, by applying nanolithographic direct-write techniques to the fabrication of silane chemistry sensors on a transparent substrate. This novel technology enables extremely fine patterns of detectors suitable for multicolor imaging of single-molecule samples at resolutions far below the diffraction limit. The extremely small size of these sensors allows for rapid, highly specific screening for hundreds of functionalities within a single, small, integrated microfluidics chip.

BENEFITS

- Fast: Rapidly interrogates, with high selectivity, very sparse samples within microfluidic systems (e.g., less than 10 microseconds)
- Precise: Offers better resolution at smaller sizes (~1 micron or less)
- Versatile: Can apply patterns using a wide range of previously incompatible materials (e.g., biologicals, chemicals, metals, polymers, small molecules dendrimers, proteins, semiconductors, insulators, thin films, etc.) and in various pH environments
- Efficient: Carries out sequential reactions with improved throughput and greater yield

THE TECHNOLOGY

This invention provides a method and system for fabricating a biomarker sensor array by dispensing one or more entities using a precisely positioned, electrically biased nanoprobe immersed in a buffered fluid over a transparent substrate. Fine patterning of the substrate can be achieved by positioning and selectively biasing the probe in a particular region, changing the pH in a sharp, localized volume of fluid less than 100 nm in diameter, resulting in a selective processing of that region. One example of the implementation of this technique is related to Dip-Pen Nanolithography (DPN), where an Atomic Force Microscope probe can be used as a pen to write protein and DNA Aptamer inks on a transparent substrate functionalized with silane-based self-assembled monolayers. But it would be recognized that the invention has a much broader range of applicability. For example, the invention can be applied to formation of patterns using biological materials, chemical materials, metals, polymers, semiconductors, small molecules, organic and inorganic thins films, or any combination of these.



Schematic of method to manufacture biomarker sensor arrays

APPLICATIONS

The technology has several potential applications:

- Life sciences - medical diagnostic systems, pharmaceutical research, biotechnology
- Security - detection of toxins and bio-weapons
- Agriculture - processing and analysis of soil samples
- Chemistry - organic and inorganic, molecular interactions
- Electronics and semiconductors
- Petroleum

PUBLICATIONS

Patent No: 8,492,160

technology.nasa.gov

NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

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More Information

National Aeronautics and Space Administration

Technology Transfer Office

Jet Propulsion Laboratory

4800 Oak Grove Drive, M/S 180-800C
Pasadena, CA 91109
818-354-7770
michael.j.vallan@nasa.gov

www.nasa.gov

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